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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/992,458	11/16/2001	Wong-Cheng Shih	TS01-045	7509

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EXAMINER

DOAN, THERESA T

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 12/02/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/992,458

Applicant(s)

SHIH ET AL

Examiner

Theresa T Doan

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 August 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) 21-23 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
 If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
 a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 3 and 10-15 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The limitations of "...wherein said silicon dioxide has a band gap of **greater than about 8.0 electron volts (eV)**", as recited in claim 3; and "...wherein said aluminum oxide has a band gap of **greater than about 8.0 eV**" as recited in claim 10, are not supported in the original disclosure.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-20, insofar as in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 103(a) as being unpatentable over Alers et al. (6,320,244) in view of Liou et al. (6,017,790) and further Yoon et al. (5,688,724) as previously cited.

Regarding claims 1, 3, 10, 12 and 16, Alers et al. teach in figure 9 a method for making a metal-insulator-metal capacitor on a substrate 30 comprising the steps of:

forming bottom electrode 44 from a first conducting layer on the substrate;

depositing a first TiO₂ insulating layer 64 on the bottom electrode;

depositing a multi-layer of high-k dielectric film 66 over the first insulating layer 64;

depositing a second TiO₂ insulating layer 68 on the multi-layer;

forming top electrode 48 from a second conducting layer on the second insulating layer 68. Alers et al. do not explicitly show the first and second TiO₂ insulating layers (64,68) are wide-band-gap. However, Liou et al. in column 4, lines 45-48 teach a metal oxide such as titanium oxide (TiO₂) is a wide-band-gap insulating material. Therefore, the first and second TiO₂ insulating layers (64,68) of Alers device, which are considered as wide-band-gap insulating layers.

Alers et al. do not teach a silicon oxide or aluminum oxide for the first and second wide-band-gap insulating layers. However, Yoon et al. teach in figure 6 a capacitor dielectric structure (column 1, lines 11-13) comprising a stack of first insulating layer 12, a dielectric film 14 of high-K and a second insulating layer 16 wherein the first and second insulating layer 12 and 16 can be selected from the group consisting of SiO₂, Al₂O₃ or TiO₂ (column 16, lines 9-12). Therefore, it would have been obvious to one

having ordinary skill in the art at the time of the invention was made to substitute an insulating layer of silicon oxide or aluminum oxide for TiO_2 because the substitution of art recognized equivalent as suggested by Yoon et al. for providing the same effects of reducing leakage current and stabilizing high effective dielectric constant (column 2, lines 31-34) is within the level of ordinary skill in the art.

Regarding claims 2, 8 and 18, Alers et al. teach in figure 9, wherein the bottom electrode 44 and the top electrode 48 are made of titanium nitride (column 4, lines 48-50 and column 5, lines 15-16). Alers et al. do not explicitly teach a range of thickness of bottom and top electrodes about 200-1000 Angstroms and a thickness of the high-k dielectric film about 50 and 800 Angstroms. However, in the text of Alers et al. teach a range of thickness can vary depending on the thickness desired (column 7, lines 47-48 and lines 56-59) in order to operate the device in its intended use. Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a thickness of the bottom and top electrodes and the high-k dielectric film in Alers's device as suggested by instant invention in order to operate the device in its intended use.

Regarding claims 5-7 and 14, it is well known that the high-k dielectric film is deposited by methods of physical vapor deposition, chemical vapor deposition and atomic layer chemical vapor deposition as taught by Alers and Yoon in order to operate the device in its intended use.

Regarding claims 4 and 19, Alers et al. teach the high-k dielectric film is a material selected from the group that includes tantalum pentoxide (figure 9, column 5, lines 12-13 and column 1, lines 43-46).

Regarding claim 17, Alers et al. teach the bottom electrode and the top electrode are made of the group that includes titanium nitride (figure 9, column 4, lines 48-50 and column 5, lines 15-16).

Regarding claims 9, 15 and 20, Alers et al. teach substantially the entire claimed structure, as applied to claims 1 and 16 above, except for the high-k dielectric film is treated in a gas selected from the group that includes oxygen, nitrogen, nitrous oxide, and ammonia, and rapid thermally annealed at a temperature of between about 300 and 700°C for a time of between about 1 and 260 seconds.

Yoon et al. teach a high-k dielectric film 14 is treated in a gas selected from the group that includes oxygen and rapid thermally annealed at a temperature of between about 400-550°C for a time of five minutes (column 4, lines 19-25) in order to reduce leakage current in a dielectric structure. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to modify the Alers et al. structure using the method of Yoon in order to reduce leakage current in a dielectric structure.

Regarding claims 11 and 13, Alers et al. teach substantially the entire claimed

structure, as applied to claim 10 above, except for a thickness of the high-k dielectric film about 50 and 800 Angstroms and a range of thickness of bottom and top electrodes about 200-1000 Angstroms. However, in the text of Aers teaches a range of thickness can vary depending on the thickness desired (column 7, lines 47-48 and lines 56-59) in order to operate the device in its intended use. Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a thickness of the bottom and top electrodes and the high-k dielectric film in Aers's device as suggested by instant invention in order to operate the device in its intended use.

5. Claims 1 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hisatomi et al. (6,163,050) in view of Ovshinsky et al. (4,766,471) as previously cited.

Hisatomi et al. teach in figure 2 a method for making a metal-insulator-metal capacitor on a substrate 33 comprising the steps of:

- forming bottom electrode 35 from a first conducting layer on the substrate;
- depositing a first SiO₂ insulating layer 36-1 on the bottom electrode;
- depositing a multi-layer of high-k dielectric film 36-2 over the insulating layer;
- depositing a second SiO₂ insulating layer 36-3 over the multi-layer;
- forming top electrode 37 from a second conducting layer on the second

insulating layer.

Hisatomi et al. do not explicitly show the first and second SiO₂ insulating layers (36-1,36-3) are wide-band-gap. However, Ovshinsky et al. in column 29, lines 61-62 teach an insulating material such as silicon oxide having a very wide-band-gap.

Therefore, the first and second silicon oxide insulating layers of Hisatomi device are considered as wide-band-gap insulating layers.

Response to Arguments

Applicant's arguments with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection.

Applicant argues that Alers et al. and Yoon do not direct one toward the use of a lower dielectric constant insulator having a wide band gap. The argument is not persuasive because the combination references of Alers, Yoon and Liou teach the limitations of the Applicant's invention as recited in claims 1, 10 and 16; Alers teaches a first and second TiO₂ insulating layers; Liou in column 4, lines 45-48 teaches a metal oxide such as titanium oxide (TiO₂) is a wide-band-gap insulating material; Yoon teaches in figure 21 the material of dielectric layers includes SiO₂, TiO₂, Si₃N₄ and Al₂O₃ (column 11, lines 12-15). Therefore, it would have been obvious to combine the references of Alers, Yoon and Liou for the first and second wide-band-gap insulating layers of a silicon oxide or aluminum oxide that having a wide band gap insulating layers. The fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

The rest of applicant's arguments, addressed to the amended claims are considered in the rejections shown above.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Theresa T Doan whose telephone number is (703) 305-2366. The examiner can normally be reached on Monday to Thursday from 8:00AM - 6:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, WAEL FAHMY can be reached on (703) 308-4918. The fax phone numbers

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for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

TD
November 24, 2003


PHAT X. CAO
PRIMARY EXAMINER